ACTA PHYSIOL. POL., 1987, 38, 2

WŁODZIMIERZ S. CSTROWSKI

LEON P. MARCHLEWSKI
1869—1946

The latter half of the nineteenth century was characterized by a rapid development of chemical and biological sciences and of an organic chemistry in particular. Owing to the research carried out by L. Pasteur, F. Hoppe-Seyler, F. Hofmeister, E. Buchner and others, the foundation of biochemistry was established at that time and the basic components of living cells, i.e. proteins, lipids, carbohydrates and nucleic acids were determined and analysed. It was the time when Leon P. Marchlewski was born.

He was born on December 15th, 1869 in Włocławek (Kujawy province) into a merchant family. After receiving his secondary education he studied first physics and chemistry at the Museum of Industry and Agriculture in Warsaw, then in 1888 he entered the Technical University in Zürich. In 1892 he received the degree of doctor of philosophy after having presented his thesis entitled: "Kritische Studien über die Sulfidschwefelbestimmungsmethoden" and accepted the post of assistant in a laboratory of E. Schunck in Manchester, England.

Marchlewski began his work with the chemistry of glycosides and soon discovered the ring structure of glucose molecule, supporting B. Tollen's suggestion which at that time was discussed among chemists interested in the chemistry of carbohydrates. In the same time Schunck was interested in the chemistry of chlorophyll and isolated several derivatives of the substance without, however, giving their characteristics. Marchlewski joined the investigations on chlorophyll and began to isolate phylloporphyrin, subsequently determining the empirical formula of the compound comparing it with haematoporphyrin, isolated some years earlier from haemoglobin by M. Nencki. He observed a great similarity between the absorption spectra of the compounds, which together with the empirical formulae suggested a common structure of both substances derived from two different kingdoms: the plants and the animals. This important discovery was published together with Schunck in 1896 in *Proc. Roy. Soc.*

Publishing the above paper was the starting point for the long cooperation of Marchlewski with Nencki. Nencki analysed phylloporphyrin obtained from Marchlewski and found haemopyrrole, exactly the same derivative obtained by him earlier from haematoporphyrin. The results of Marchlewski's and Nencki's fundamental work were published in a joint paper in 1901 (*Ber. deutsch. Chem. Gessell.*).

In 1900 Marchlewski accepted the proposal to head the Chair of the Department of Medical Chemistry, Jagiellonian University, Kraków, and immediately started further investigations on the chlorophyll moiety. From phylloporphyrin he obtained haematinic acid, identical to that obtained by Küster from haemoglobin. In the next years, from the products of bacterial decomposition of chlorophyll, he isolated another derivative, phylloerythrine which later was found to be the key compound for elucidation of the final structure of the chlorophyll molecule. In cooperation with J. Z. Robel they introduced iron atom into the central position of the porphyrin ring of phylloerythrine and called the compound phyllohaemin, which closely resembled haemin obtained from human haemoglobin.

In 1903 L. Marchlewski became member of the Academy of Sciences in Kraków and was continuing fruitful research on the structure of chlorophyll up to the First World War, which disorganized the scientific activity. Marchlewski devoted himself to intense social activities and assistance to the victims of war. After the war he was active in establishing of the State Institute of Agriculture in Puławy, Institute of Farming in Bydgoszcz and started to resume research work in Cracow's laboratory.

During the interwar period Marchlewski worked mostly on chemistry and spectral properties of sugars and other organic compounds. Entering the Polish Peasant Party "Piast" he undertook social and political activity mostly in the Senate of the Polish Republic. In 1927 he became Rector of the Jagiellonian University and he was also serving as Vicepresident of the Polish Academy of Sciences in Kraków. He died on January 16th, 1946.

During his long scientific career Marchlewski was a leading figure in Polish science for almost 40 years. He was the author of more than 200 publications: experimental works, reports, monographs, textbooks and discussions. His research greatly contributed to the position of our country in the world sciences.

Extrait du Bulletin de l'Academie des Sciences de Cracovie
Classe des Sciences Mathematiques et Naturelles, Juin 1904

THE PROBABILITY OF THE IDENTITY OF PHYLLOERYTHRINE AND CHOLEHAEMATIN

by LEON MARCHLEWSKI

Amongst the numerous colouring matters known to be contained in the bile cholehaematin is by no means the least interesting one, but the great difficulty in obtaining larger quantities of this body made a thorough examination of its properties an impossibility. We owe our knowledge, scant though it be, of this substance chiefly to English scientists, namely Heysius and Cambell[1], MacMunn[2] and Gamgee[3]. The three first named studied the optical properties of cholehaematin, whereas Gamgee quite conclusively showed that the fresh bile of the ox or sheep does not contain the colouring matter, but a chromogen (or chromogens) which on contact with air gives rise to the colouring matter. I am indebted to Prof. Dr. A. Gamgee F. R. S. for calling my attention to this interesting body and also for the suggestion that phylloerythrine, a substance which I isolated[4] from the faeces of a cow fed on grass, might possibly be identical with cholehaematin. I may be permitted to quote a passage from the letter prof. Gamgee addressed to me on the 10th of March 1904. "I have always had the conviction that cholehaematin is not a derivative of haemoglobin but of chlorophyll and now, after your work on phylloerythrine I am more persuaded than ever. It, I am sure, is a product of animal metabolic processes acting on chlorophyll, whereas it is quite possible that phylloerythrine and Schunck's scatocyanin are products of the action of the digestive juices on chlorophyll. In the first place there is the fact that cholehaematin is only found in the bile of the herbivora and so far as I know only in the bile of the sheep and ox. The bile of the horse does not contain it, though I have never had the chance of examining the bile of horses fed entirely on grass. It would be strange if of the grass eating animals the ox and the sheep were the only creatures whose bile contained it. In the second place there is a very remarkable resemblance between the spectrum of cholehaematin and that of your new body".

"In the third place Mac Munn who gave the name cholehaematin to the substance, because he believed it to be a derivative of haematin, found that the body when treated with sodium amalgam yielded a substance with a spectrum very closely resembling that of haematoporphyrin. In the light of your researches, it is infinitely probable that this was phylloporphyrin".

The great resemblance of the spectra of cholehaematin and phylloerythrine refered to, indeed a striking one as will be seen from the following measurements:

	Phylloerytrine in chloroform (Marchlewski)		Cholehaematin (Mac Munn and Gamgee)
Band I:	λ —642 — 640	Band I:	λ —649 — (centre)
Band II:	λ —606 — 581	Band II:	λ —613 — 585
Band III:	λ —577 — 557	Band III:	λ —577.5 — 561.5
Band IV:	λ —536 — 515	Band IV:	λ —531 — 521.5

---

[1] *Pflügers Archiv.* Bd. IV. p. 540.

[2] *The Spectroscope in Medicine.* London 1880.

[3] *Die physiologische Chemie der Verdaung* etc. Leipzig 1897. p. 346.

[4] This Bull. 1903. p. 638.

I thought it therefore worth while to compare phylloerytrine and cholehaematin by direct observation.

The contents of several gall bladders of sheep which were fed exclusively on grass, were left to stand for two days, in the presence of air, a little water added and the mixture which was of an olive colour with a reddish hue examined through the spectroscop. I noticed four absorption bands. The first is very badly deffined, its more refrangible edge corresponds to the wave length 635, the position of the other edge it was impossible to ascertain in consequence of a more or less continuous strong absorption of the orange and red rays. The second band is determined by the following wave lengths: λ —611 — 685.5, the third λ —577 — 563, the fourth λ 534.5 — 522.

The next measurements were carried out using a chloroformic extract of the bile, which I prepared more or less according to Mac Munns prescription. The gall-bladder contents were acidulated with acetic acid, absolute alcohol added, filtered and the filtrate extracted with chloroform. The chloroformic extract possessed an olive colour with a very strongly pronounced reddish tint. A direct comparison of this solution with a chloroformic solution of phylloporphyrin containing a little chloroform, taking care that the concentrations correspond with each other as closely as possible proved that their spectra are indeed almost identical. The positions of the bands correspond to the following wave lengths.

Band I:	Beginning of band λ 638	Beginning of band λ 637
Band II:	λ —604 — 582	λ —603 — 580
Band III:	λ —572 — 559	λ —570 — 558
Band IV:	λ —532 — 517	λ —530 — 515

The bands caused by the cholehaematin solution are scarcely perceptibly shifted towards the red end of the spectrum as compared with those of phylloerythrine. According to their intensities the bands may be placed in identical order: III, II, IV, I, the band I being the faintest. We see therefore that so far the similarity of the optical properties of both solutions is indeed remarkable. There is however also a difference in the spectra which is perhaps of not much importance. I found that the above cholehaematin solution causes in addition to the four bands mentioned, a fifth placed on the *F*-line corresponding to the wave lengths λ —504—484. MacMunn noticed such a band in the crude bile solutions, but does not mention it as belonging to the pure cholehaematin[1]. It is therefore quite possible that my cholehaematin solutions were not as pure as those prepared by Mac Munn, they might for instance contain some urobilin, which causes a band in the spectral region named.

I was especially anxious to examine the absorptions caused by both colouring matter in the invisible part of the spectrum, because they are especially characteristic for all derivatives of the blood colouring matter and of chlorophyll. Phylloerythrine is characterised as I have shown by two bands, a broad and dark one in front of the *K* line and fainter band just behind that line. Cholehaematin causes a similar absorption, but of the two bands the darker and broader is placed behind the K_β line. An absolute identity is therefore also wanting in this case what may be also due to impurities contained in the crude cholehaematin solution at my disposal.

The identity of cholehaematin and phylloerythrine is according to the above results no doubt highly probable, but not absolutely certain. The irreproachable proofs can be supplied only by a comparison of the pure substances, isolated in the crystalline state. The difficulties in the preparation of pure phylloerythrine have been overcome. Not so in the case of cholehaematin. As far as I can judge a thousand of sheep biles would have to be worked up in order to isolate it in the pure state, a task which at the present time is beyond my powers. Should it at some future time be possible to surmount the difficulties and to prove that the two substances in question are really identical, there could not be any doubt that some of the chlorophyll or one of its derivatives is assimilated by the animal body and passed on, after undergoing some changes, by the portal system towards the liver and then to the gall bladder.

---

[1] Unfortunately, Mac Munns original papers are not accessible to me. The above data I owe to Gangee's excellent book mentioned before.

In view of the great difficulty in solving this question by purely chemical and physical methods, it would be worth while to attack it also by a physiological method. Wertheimers[1] researches will be at this junction of considerable help. This author proved that the bile of the dog flowing from a temporary biliary fistula exhibited no absorption bands which appeared however after slowly injecting, varying quantities of sheeps bile into one of the femoral veins. This cholehaematic bile of the dog ought to be produced also by injecting a solution of phylloerythrine. Furthermore it is necessary yet to examine throughly the influence of various kinds of food on the nature of the bile colouring matters of herbivora.

I hope to be able to return to this subject at some future occasion. The action of reducing agents on phylloerythrine in view of the result quoted above of Mac Munn relating to cholehaematin, occupies my attention at the present moment.

---

[1] *Archive de Physiologie*, 1891. p. 724